

Chapter 15

PARASITOLOGY IN NURSING PRACTICE

Winifreda O. Ubas-de Leon

INTRODUCTION

Nurses perform important roles in the delivery of basic health services, both in the rural and urban settings. They conduct health promotion, health maintenance and disease prevention activities as health team members with these designated health education functions. They are challenged to help improve health and living conditions through family and community empowerment. Recent studies have documented the importance of political advocacy and client empowerment to prevent and control communicable diseases in the community (Maglaya 1999; de las Llagas 1999).

Apart from the nurses' major role on health promotion and maintenance, another critical area of concern is related with managing health problems/diseases in many parts of the Philippines, especially in doctor-less rural villages where communicable diseases are prevalent. Competencies on accurate diagnosis for prompt and appropriate treatment are necessary for client care.

This chapter will deal basically with parasites as causative agents of selected communicable diseases encountered in community nursing practice. Some of the diseases, like malaria, filariasis and schistosomiasis, are endemic in specific communities because of the presence of vectors or intermediate hosts in the locality. Others are prevalent among population groups and marginalized cultural/ethnic communities where unsafe drinking water supply, unsanitary waste disposal and unhygienic practices are still the prevailing conditions. Sections of this chapter will discuss the life cycle of each parasite to illustrate the foci of prevention and control measures. Appropriate laboratory tests for diagnosis and management options for the communicable diseases are also specified. Discussion on the laboratory procedures can be utilized either as requisite competency for appropriate referral to laboratory facilities or as additional diagnostic skill that the nurse practitioner can learn for prompt and appropriate treatment. This competency is especially useful in areas where laboratory technicians are not accessible and drug resistance is becoming a big problem as a consequence of use of radical treatment without laboratory confirmation of presenting signs and symptoms.

THE PARASITES

Parasites are organisms that live in or on the body of another organism for survival. The primary needs of the parasite such as food and shelter are provided by that other organism technically known as the host. This relationship can be best exemplified by man as the host and hookworm as the parasite.

Parasitic organisms are found practically everywhere: air, food, water, soil, inanimate objects like linen and clothing. Some are carried by insects like bugs, flies and mosquitoes, while some survive in some animals like swine, cow and cattle. While majority of the parasites are found within or inside the body of a host, there are those that are found outside the body of the host like skin mites and head lice.

They are able to invade the host using different portals of entry, but the most common is still through the mouth. A few are able to actively penetrate the skin or are passively introduced into the host by some insects. Infected individuals may or may not show signs and symptoms of infection. Those who do not show the signs and symptoms may however serve as carriers and extra source of infection.

Most parasites live in human and animal intestines, and are usually passed out with the feces. However, parasites have also been recovered from other organs like the liver, lungs, brain, meninges, lymph nodes, lymph vessels, subcutaneous tissues, muscles, reproductive organs, blood vessels, blood cells and even the eyes.

Parasites may be single celled called the protozoa or may be multicellular call "worms" or "helminthes." The collective term applied to worms found in the human intestines is "intestinal helminths" and infection is "intestinal helminthiasis" which is one of the top causes of morbidity worldwide. The most vulnerable sector of the population are the children.

There are few parasitic infections which can cause death like malaria and capillariasis. A few may cause permanent disability like elephantiasis due to filariasis. There are increasing evidences today that associate parasitic infections with malnutrition, poor learning ability and growth retardation. Infected individuals often manifest abdominal discomfort, lack of appetite, hunger pangs and loss of weight. As a whole, parasitic infections can affect the economic productivity and quality of life of an infected individual in particular. If the parasitic infection is present among a big segment of the population, then the effect of this parasitic infection is magnified.

The following sections will discuss the parasites according to the different modes of transmission. The life cycle of each parasite show the points where spread of infection can be prevented or controlled. Illustrations of the life cycles were adapted from handouts given to students of the course on parasitology at the Uniformed Services University of Health Sciences in Maryland, USA.

DIRECTLY-TRANSMITTED PARASITE

Enterobius (Oxyuris) vermicularis

This parasite is also known as the human pinworm or seatworm. It causes an intestinal infection with worldwide distribution. Infected individuals usually suffer from intense perianal itching which maybe complicated with secondary bacterial infection. Because of itching, most patients have disturbed sleep resulting to nervousness and irritability.

Enterobiasis or oxyuriasis is observed in places where there is overcrowding and water supply is inadequate for personal hygiene. Eggs of the parasite have been found in fingernail clippings, door knobs, faucet tops, and even from the keys of the piano and keys of typewriters.

Eggs are deposited in the perianal region causing contamination of underwear and bed linens. Outside the host, eggs become infective in four to six hours. Transmission takes place either through ingestion or inhalation of the eggs (See Illus. 15.1). Infection is easily transmitted to the other members of a family or a group. Adult worms may be found crawling out of the anus but the choice of diagnosis is recovery of eggs using the Scotch tape method in swabbing the perianal region (See Illus. 15.2). Specimen

collection is best done in the morning prior to a bath and/ or washing the perianal region like in defecation.

Specific drugs must be administered. Personal hygiene like proper hand washing and keeping finger nails short must be advocated. Contaminated linens and clothing of the patient must be properly sterilized through boiling.

SOIL-TRANSMITTED PARASITES

Some parasites are passed out into the soil, where they undergo further development until they become infective. These parasites remain as major public health problem not only in the Philippines but in many tropical and subtropical countries as well. Children who live in areas where there is unsanitary human fecal disposal are often infected by soil-transmitted parasites.

Ascaris lumbricoides

This is also known as the giant intestinal roundworm. Adult roundworms live in the small intestines. Fertilized and unfertilized eggs are passed out by the female ascaris. In about two weeks, fertilized eggs develop in the soil into embryonated stage which is the infective stage. Soil is commonly contaminated in areas where there are no sanitary toilet facilities or where human feces is used as fertilizer in vegetable gardens.

Man acquires infection when these infective eggs are swallowed mainly via contaminated food. Upon ingestion, the larva is released from the eggs and then undergoes lung migration. During this larval migration, the patient will usually manifest pulmonary symptoms like chest pain, cough and fever. The parasite will then settle in the small intestines to develop into the adult stage (See Illus. 15.3). With the presence of adult ascaris, the most common symptom is vague abdominal pain.

At times patients may harbor a high number of worms resulting to intestinal obstruction. Some vomit out these adult worms as well. There are reported cases when adult worms undergo erratic migration to other organs like the liver and even the common bile duct.

Ascariasis is established when adult worms are expelled by the patient. However, expulsion of the adults does not happen all the time, so in the laboratory, stool examination is done to determine the presence of fertilized or unfertilized eggs. Techniques recommended include the direct fecal smear and the Kato thick smear preparation. To determine the intensity of infection, the Kato-Katz (which is a quantitative method) is recommended.

The patient must be properly treated periodically with broad spectrum anthelmintic, because rapid re-infection has been reported. Stools should be properly disposed and should not be used as fertilizer. Proper hand washing must also be encouraged. Vegetables that are usually eaten raw must be thoroughly washed before consumption.

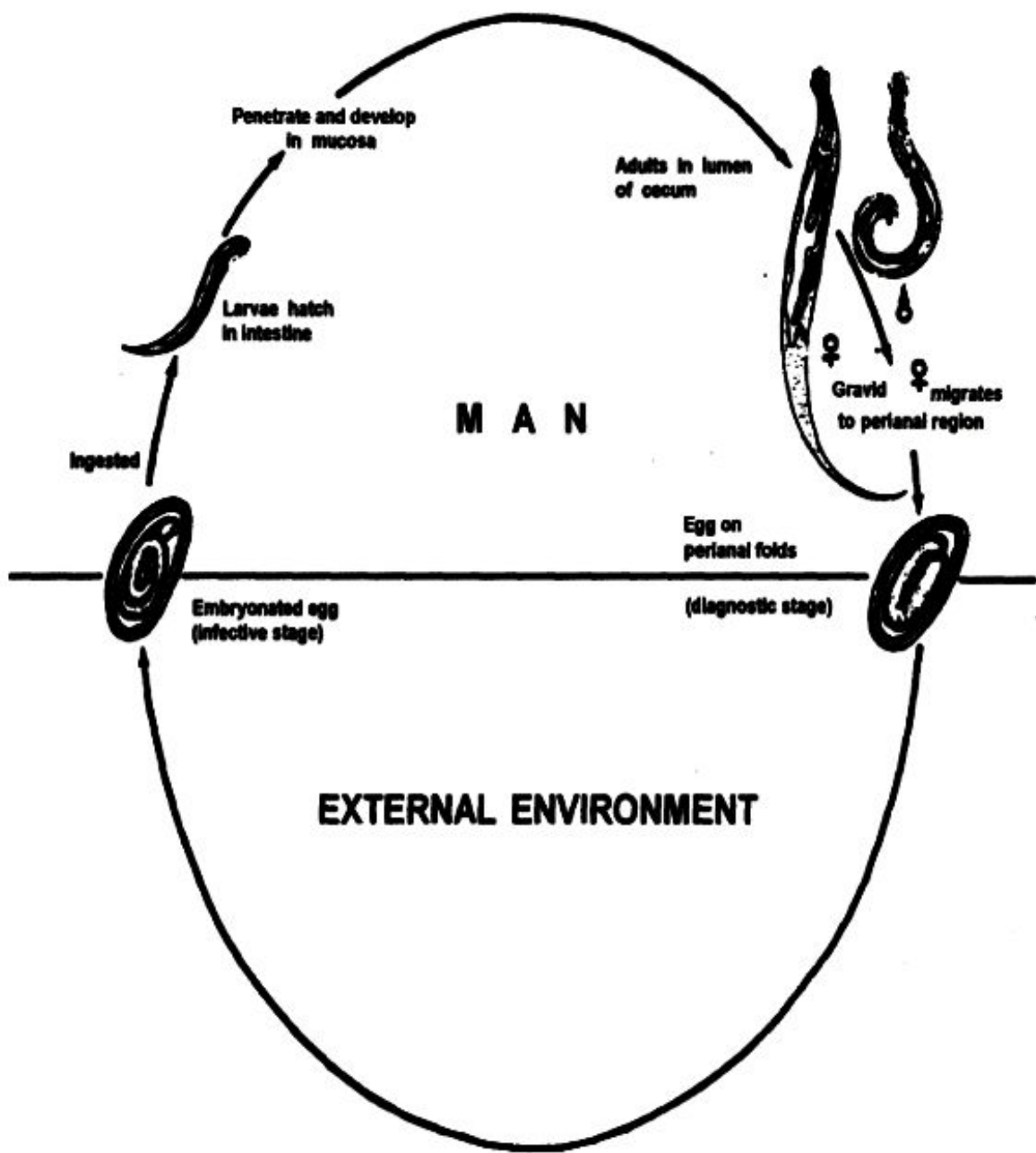


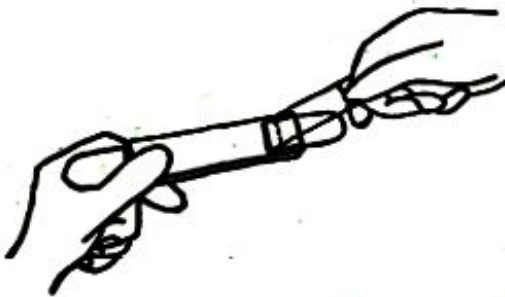
Illustration 15.1 Life Cycle of *Enterobius vermicularis*



1. An unused Scotch-tape swab preparation.



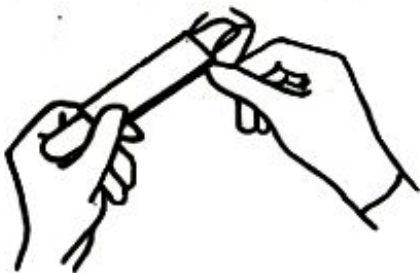
4. Hold tape and slide against tongue depressor.



2. Hold slide against tongue depressor one inch from the end and lift long portion of tape from slide.



5. Separate the buttocks and press gummed surfaces against several areas of perianal region.



3. Loop tape over end of depressor to expose gummed surface.



6. Replace tape on slide and smooth it out with the thumb.

Plate 1. How To Use the Scotch-tape Swab (Modified from Brooks, Donaldson and Mitchell, 1949).

Illustration 15.2 How To Use the Scotch-tape Swab (Modified from Brooke, Donaldson and Mitchell, 1949)

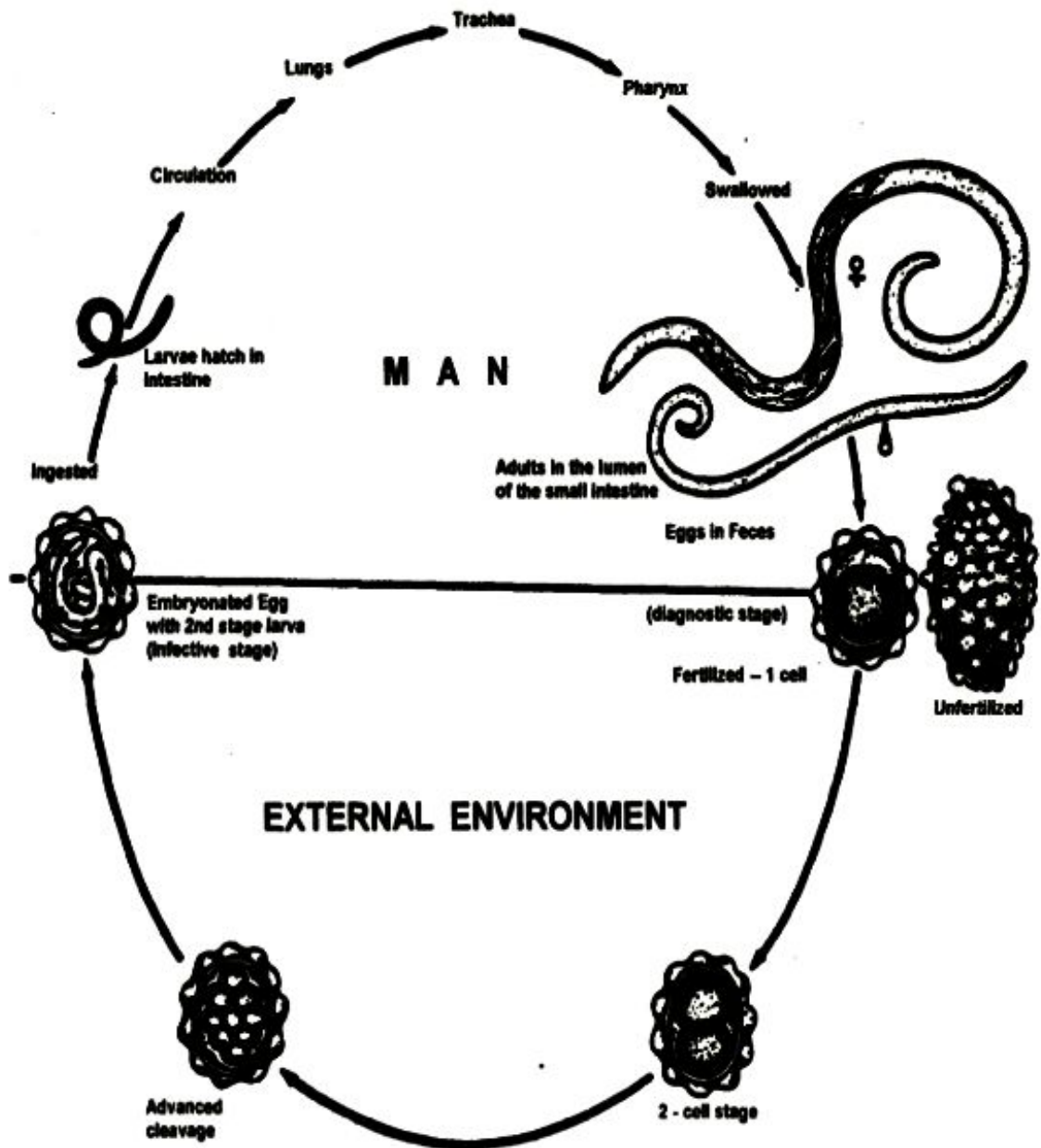


Illustration 15.3 The Life Cycle of *Ascaris lumbricoides*

Trichuris trichiura

This worm is also known as the whipworm because the anterior end is highly attenuated and the posterior end is thicker and more fleshy. It is another common intestinal worm and is usually found together with *Ascaris*.

Trichuris eggs that are passed out by the female worm embryonate in the soil in two to three weeks. When these infective eggs are ingested, larvae are released. They then migrate to the large intestines particularly the caecum, where they develop into the adult worms (See Illus. 15.4). The attenuated anterior end penetrates the intestinal mucosa.

In light infection, the patient is usually asymptomatic. In cases of heavy worm burden, the patient may suffer from abdominal discomfort and blood-streaked diarrheal stools. Bleeding sites have been observed at the site of attachment. There are available evidences in the cases of heavy worm infection, anemia may develop. Heavy infection may, likewise, result to rectal prolapse.

The direct fecal smear, Kato thick and Kato-Katz techniques are very useful in the recovery of *Trichuris* eggs during stool examination in the laboratory.

Like *Ascaris*, *Trichuriasis* can be controlled and prevented through periodic treatment, use of sanitary toilet facilities and proper hygienic practices.

Hookworms

These are blood sucking roundworms, because they can get attached into the intestinal mucosa of the small intestines through their buccal capsule. This buccal capsule is provided with a definite dental pattern, which can help in species identification. The two common species of hookworm are *Necator americanus* and *Ancylostoma duodenale*. In the Philippines, *Necator americanus* has a wider distribution compared to *Ancylostoma duodenale*. Animal hookworms are also existent namely: *Ancylostoma braziliense* of cats and *Ancylostoma caninum* of dogs.

The eggs of these two parasites are very difficult to differentiate. When these eggs reach the soil through indiscriminate defecation, they rapidly embryonate and after 24 - 48 hours, the rhabditiform larva is released. In about 7-10 days, the rhabditiform larva develops into the infective filariform larva.

Human infection occurs when the filariform larvae penetrate the skin. After skin penetration, the patient develops some form of dermatitis commonly called ground or dew itch. The larvae then migrate to the lungs and the patient manifests pulmonary symptoms like coughing and wheezing. Then the parasites proceed to the small intestines where they develop into the adult worms (See Illus. 15.5).

The presence of adult worms in the intestines may result to abdominal pain. Because of the buccal capsule, the parasite is able to bite into the intestinal mucosa and while biting is able to suck out blood from the host. For as long as the worm is attached, the patient suffers from a constant blood loss which may result to microcytic hypochromic anemia. Development of anemia, however, is determined by the worm burden and the iron status of the patient.

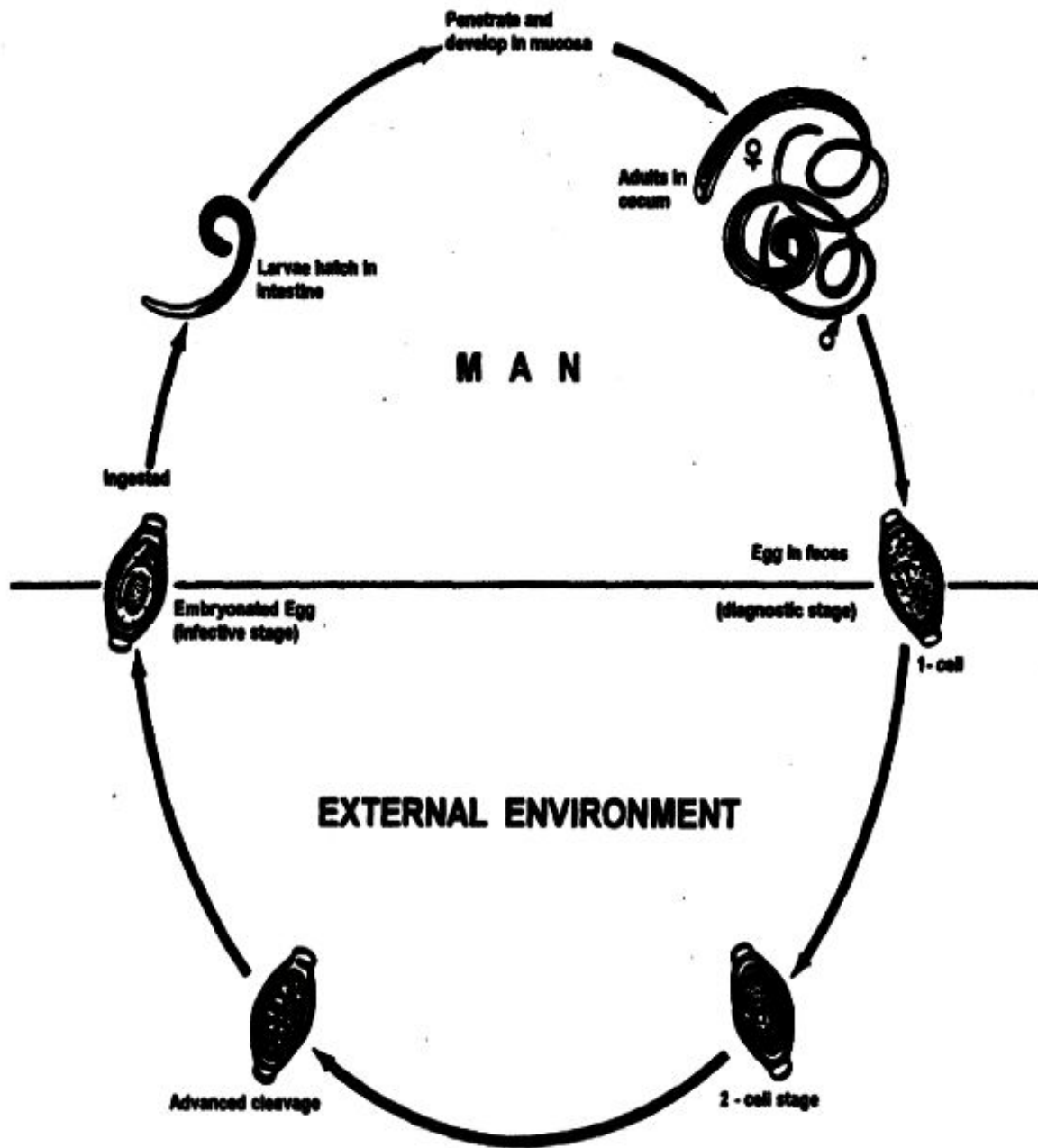


Illustration 15.4 Life Cycle of *Trichuris trichiura*

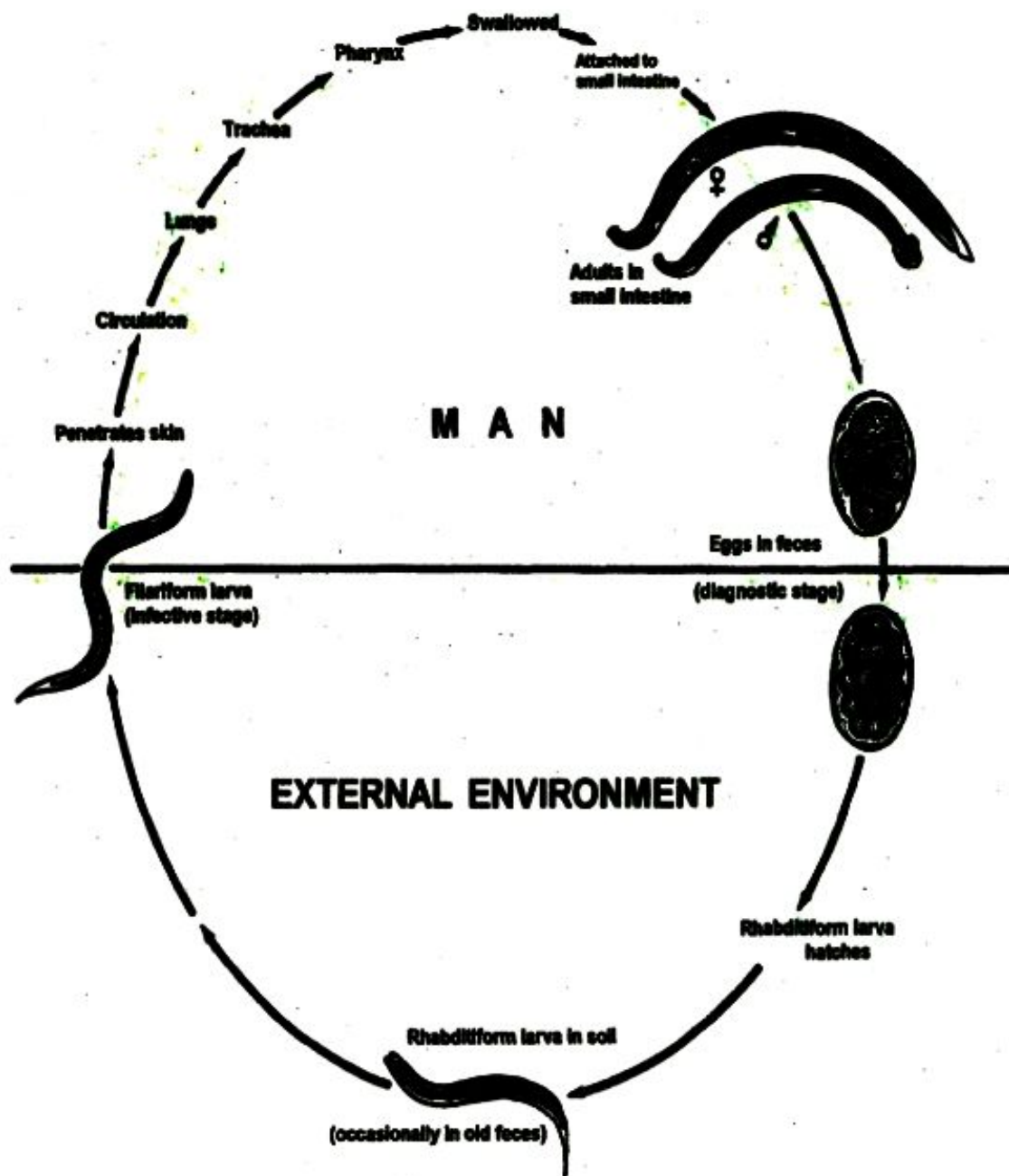


Illustration 15.5 Life Cycle of Hookworm

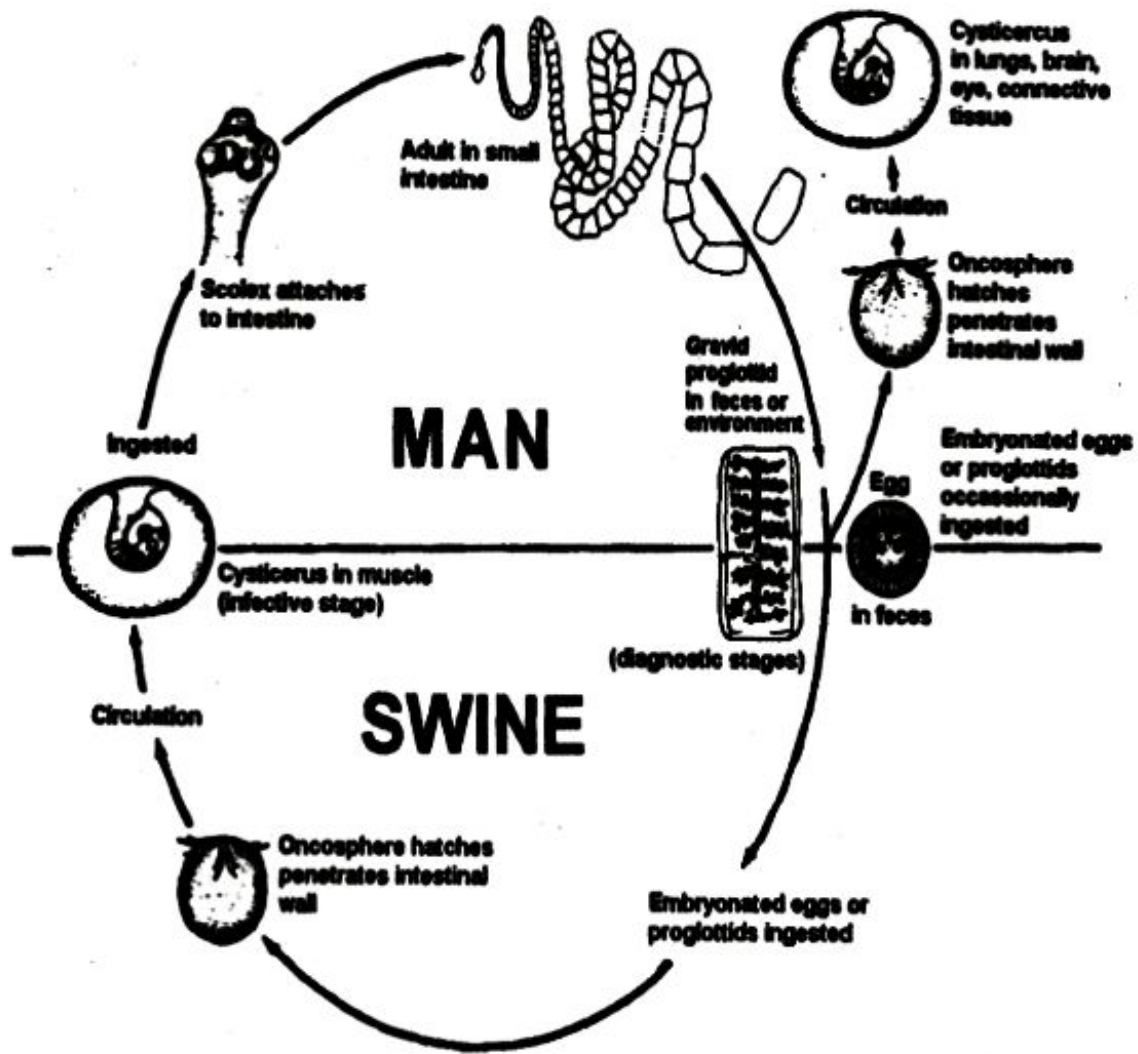


Illustration 15.6 Life Cycle of *Taenia solium*

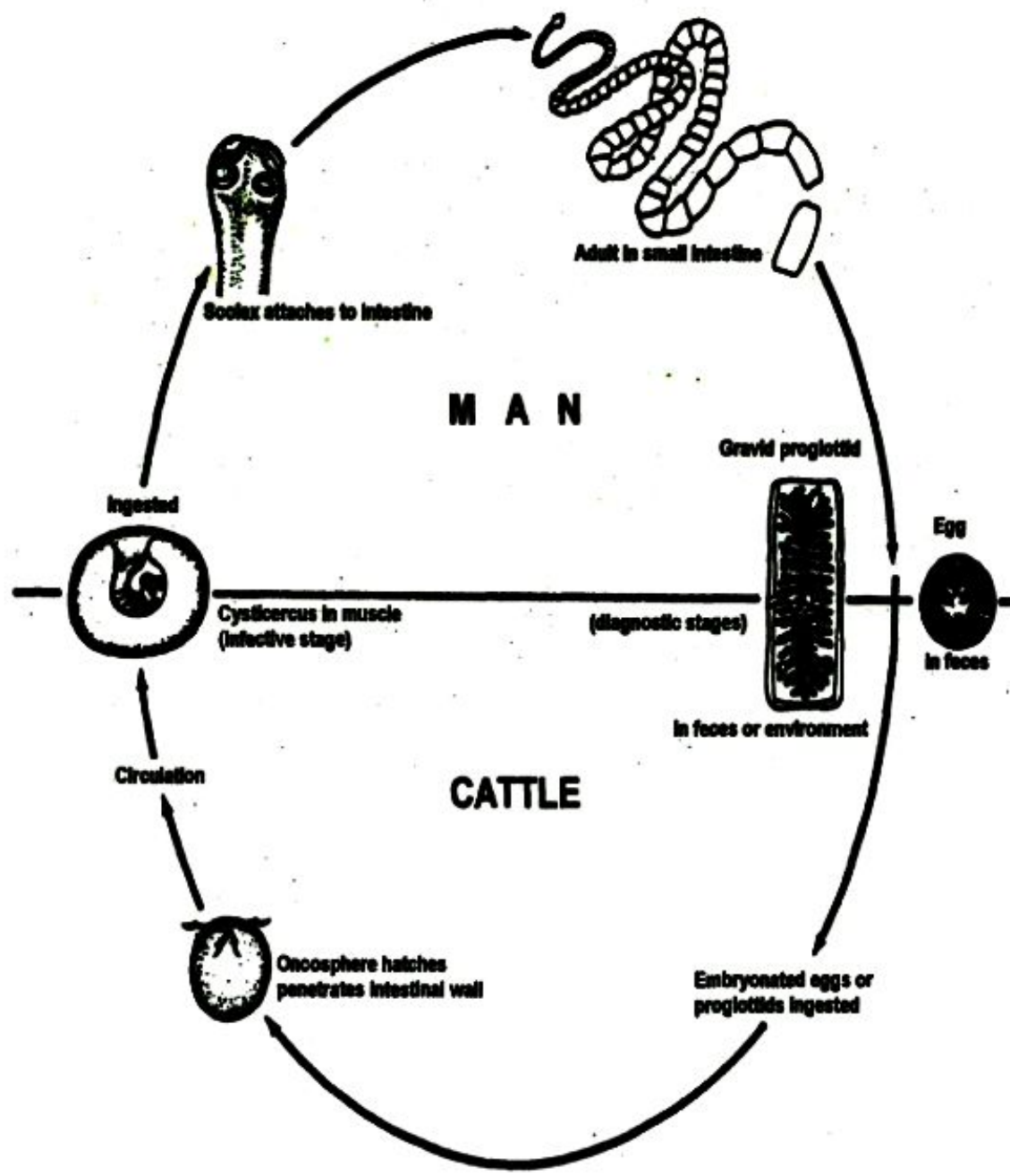


Illustration 15.7 Life Cycle of *Taenia saginata*

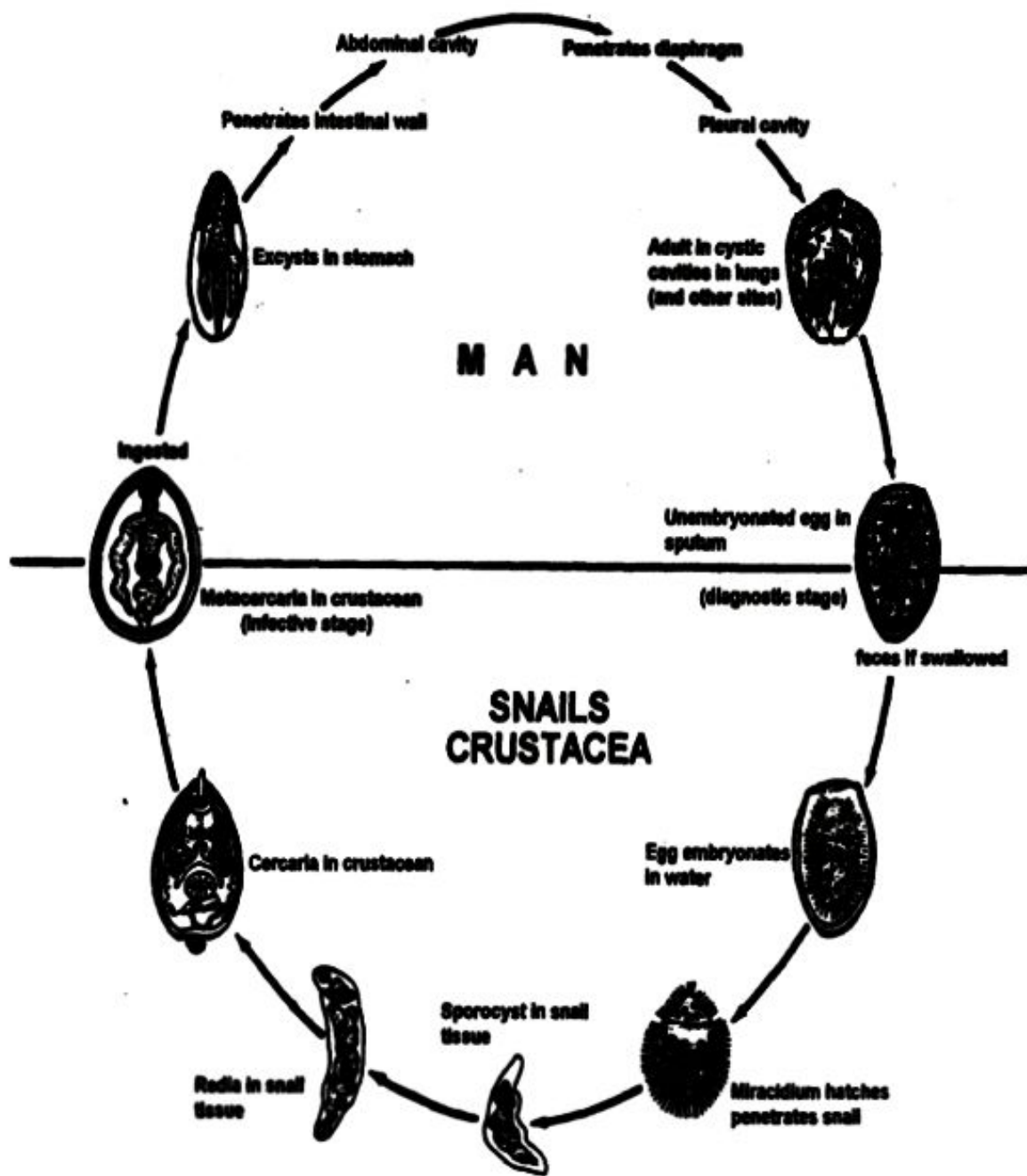


Illustration 15.8 Life Cycle of *Paragonimus westermani*

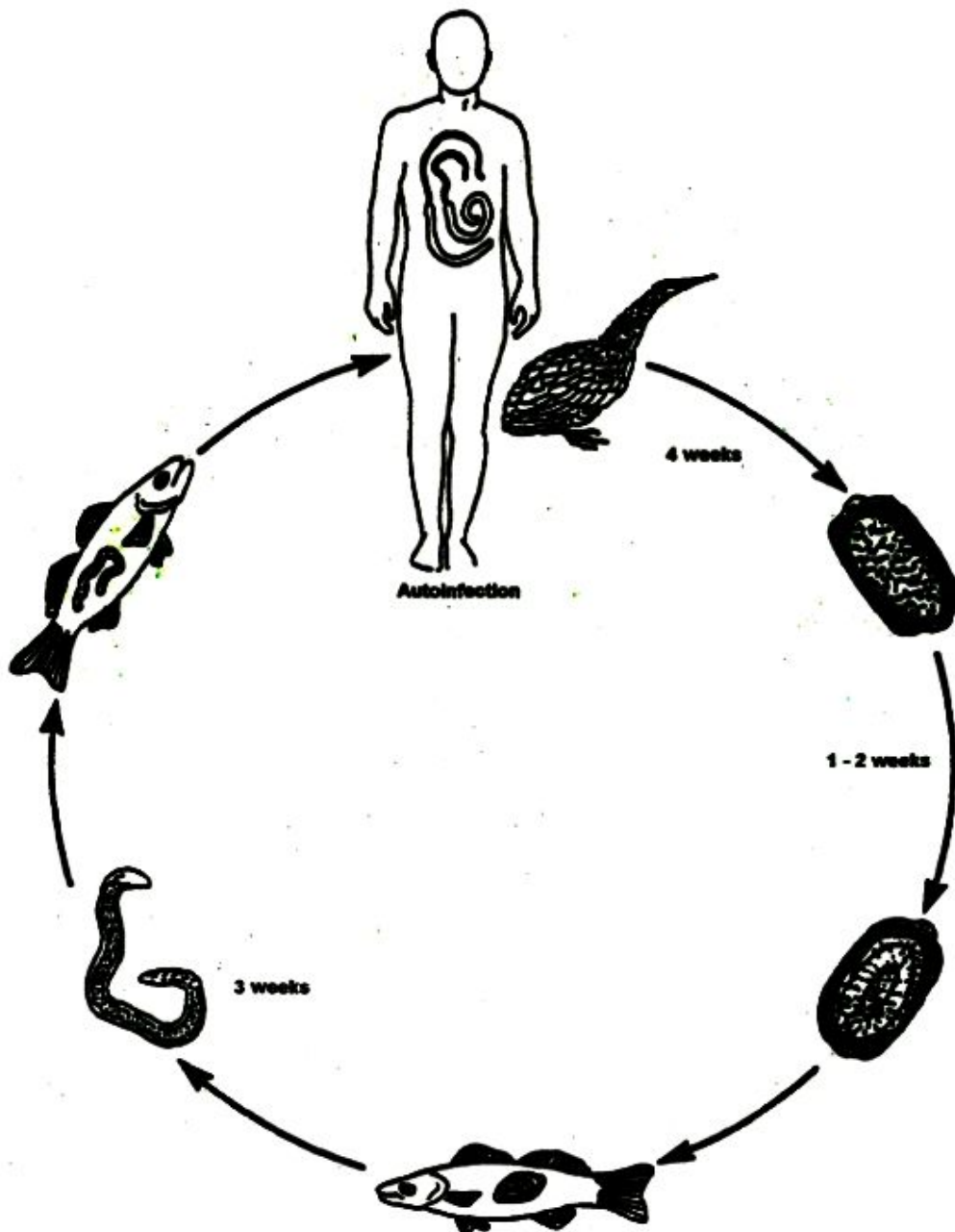


Illustration 15.9 Proposed Life Cycle of *Capillaria philippinensis*

Hookworm infection (necatoriasis or ancylosomiasis) is often found in areas where people are not protected from skin contact with the infected soil like in most agricultural areas. It might be good to add that for *Ancylostoma duodenale*, ingestion of filariform larva from contaminated food mainly vegetables has been found to cause infection in some countries like Papua New Guinea and Africa.

Final diagnosis of hookworm infection is dependent on the recovery of hookworm ova from the stool. Species identification however, cannot be established through the eggs. Studies show that a direct fecal smear and/or the Kato thick smear is not very efficient compared to the formalin ether concentration (FECT) procedure.

Use of broad spectrum anthelmintics have been effective in the treatment of infected individuals. Iron supplementation and proper diet are useful in patients with anemia.

On the other hand, if man is exposed to the filariform larvae of the animal hookworms, the skin lesions are more serious, because the filariform larvae remain on the skin resulting in what is known as creeping eruption or cutaneous larva migrans. They do not reach the circulation and therefore do not develop into the adult hookworms in man.

Health education must be strongly advocated in relation to use of sanitary toilet facilities and wearing of appropriate footwear like slippers, shoes and/ or boots.

FOOD TRANSMITTED PARASITES

Man may acquire parasitic infections through the consumption of improperly cooked or raw food like meat, crustaceans like crabs and crayfish, fish, snail and vegetables. These infections are generally related to the eating habits of the population and to a lesser extent to the beliefs that eating raw food is actually a healthy practice. In some areas, however, lack of fuel for cooking purposes or lack of food in general contribute to the occurrence of food-transmitted parasitoses.

Taenia solium and Taenia saginata

The adult stages of both parasites are found in the intestines of man and their eggs are indistinguishable. The eggs of *Taenia solium* may be ingested by the pigs while the eggs of *Taenia saginata* may be ingested either by the cow or the cattle. The eggs, when ingested, will develop into encysted larvae called cysticerci: *Cysticercus cellulosae* in pigs and *Cysticercus bovis* in cows/cattle. Man acquires the adult infection when pork and/ or beef are ingested raw or improperly cooked (See Illus. 15.6 and Illus. 15.7).

Gravid segments can be properly speciated by counting the number of lateral branches arising from the main uterus stretched at the center of the segment. *Taenia solium* branches number 8 – 12 while *Taenia saginata* has more than 13. Eggs can be recovered from the stool or the perianal swab.

Manifestations of the adult infection range from nervousness, insomnia, poor appetite, to abdominal pains with digestive disorders. Many cases are, however, asymptomatic. But the majority of patients complain of annoyance due to the emergence of tapeworm segments per anus.

Proper treatment of Taeniasis must be given to the patient. Recovery of the scolex from the patient after therapy is the gauge of successful treatment. Health education must emphasize thorough cooking of meat. Freezing of meat at less than 5 °C can kill

the cysticerci as well. Proper disposal of human feces will prevent access of animals to human feces.

For added information, there is a larval infection of man due to the accidental ingestion of *Taenia solium* eggs. Like in pigs, *Taenia solium* eggs will also develop into the cysticerci encysted in the different tissues of man. The cysticerci have been reportedly found in the subcutaneous tissues, striated muscles, eyes, heart and even the central nervous system of man. Involvement of the central nervous system is called neurocysticercosis. Many cases of seizures of unknown origin have been associated with this condition.

Furthermore, there are studies to show that in Asia, another species of *Taenia* called *Taenia asiatica* is in existence. Its presence in the Philippines has been established when segments from patients at the Department of Parasitology, College of Public Health University of the Philippines Manila were brought to Japan and were examined for the mRNA specific for *Taenia asiatica*.

Paragonimus westermani

This trematode, known as the Oriental lung fluke, is usually found in pairs inside cysts in the lung parenchyma of the final host, which could be man or animal reservoir host like cats and dogs. Eggs of the parasite that escape from these cysts are either coughed out with the sputum or swallowed back, and then passed out with the stools.

These eggs are immature and embryonate to develop the miracidium in water. The miracidia once released, enter the snail intermediate host where development into sporocysts, rediae and cercariae occurs. The cercariae go out of the snail to penetrate the second intermediate host which is a fresh water mountain crab. The cercariae develop into the infective metacercariae in the gills, heart, legs and muscles of the crab. Man can, therefore, acquire the infection through the ingestion of raw or improperly cooked crabs (See Illus. 15.8). Adult worms then settle in the lung parenchyma. There are cases where the adult worms have been found in extra-intestinal sites, like the abdomen, the diaphragm and rarely even in the brain.

During the early stage of the infection, the patient may be asymptomatic but later on, the patient will suffer from dry cough producing blood-tinged purulent sputum. There could also be fever, chest pain, dyspnea, easy fatiguability and generalized myalgia. Because of these signs and symptoms, the condition can be misdiagnosed and wrongly treated as pulmonary tuberculosis. In some instances, paragonimiasis may co-exist with tuberculosis.

Definitive diagnosis is established through the recovery of *Paragonimus* eggs either from the sputum or the stools. Serologic tests are useful if the worms are localized in the extra-intestinal organs.

Paragonimiasis is primarily found in the Far East which includes the Philippines. In the Philippines, the parasite has been identified in the following provinces: Mindoro, Sorsogon, Camarines, Samar, Leyte, Davao, Agusan, Cotabato and Zamboanga. Rats, cats and dogs serve as reservoir of infection in these endemic foci. In Japan, wild boars can serve as paratenic hosts.

Praziquantel is available for the treatment of Paragonimiasis. Recently, a research group from the College of Public Health did a drug trial for paragonimiasis using Triclabendazole. The efficacy was found to be about the same as Praziquantel. There

must be a strong advocacy on thorough cooking of crabs and safe food preparation. While use of sanitary toilets can contribute in preventing eggs from reaching the intermediate snail host, there are other animal reservoir hosts that can continue this chain of transmission.

Capillaria philippinensis

This is another intestinal roundworm that was first described among humans in the Philippines way back in 1963. Eggs of the parasite that apparently embryonate in water are ingested by fresh or brackish water fish, where they develop into infective larvae. Man acquires the infection upon ingestion of raw or improperly cooked fish (See Illus. 15.9).

Capillaria infection or capillariasis causes abdominal pain, gurgling of the stomach called borborygmi and chronic diarrhea. The intractable diarrhea causes remarkable loss of weight, loss of appetite, body malaise, then edema.

Infection is established through the recovery of eggs, larvae and adults from the stools. In areas where epidemic outbreaks have occurred, one of the main problems identified was the inability of the laboratory microscopist to differentiate Capillaria eggs from Trichuris eggs.

Early diagnosis is essential for early treatment. If the problem is not immediately diagnosed, the patient usually dies due to loss of protein, low electrolyte level and malabsorption of fats and sugars.

The infection was primarily thought to be present only in the Northern Luzon provinces of Ilocos Sur, Ilocos Norte, La Union, Cagayan, Isabela, Pangasinan and Zambales. Later on, it was found also in the Visayan province of Southern Leyte and in Mindanao (mainly in the provinces of Davao, Basilan, Agusan, Zamboanga del Sur, Zamboanga del Norte, and Compostela Valley).

All infected individuals must be properly treated. Health education must be focused on the risk of eating raw or improperly cooked fish. Use of sanitary toilet facilities must, likewise, be emphasized. Laboratory workers must be properly trained on the identification of the parasite as well. It was found that laboratory diagnosticians may mistake eggs of Capillaria for the eggs of Trichuris.

Heterophyid Flukes

This is a group of flukes that live in the small intestines of man and other fish-eating animals like rats, cats and dogs. They are composed of several species. The ones commonly identified from man are: *Heterophyes heterophyes*, *Haplorchis taichui* and *Metagonimus yokogawai*.

They are considered the smallest among the trematodes because they measure only 2 mm. or less in length. The eggs produced are also very small but they are already with miracidia when they are passed through the feces. The miracidia hatch out once the eggs are ingested by the appropriate snail intermediate host. The cercariae released from the snail will then encyst as metacercariae in fish which is the second intermediate host. Man acquires the infection upon ingestion of raw or improperly cooked fish caught from fresh water, brackish water (rivers or lakes) or even salt water (oceans). It was a common observation that patients with heterophyidiasis are concomitantly infected with capillariasis, since the same species of fish were found to harbor the

infective stage of both parasites.

Infected patients normally suffer from epigastric pain and are clinically diagnosed as peptic ulcers. Inflammation at the site may result to colicky pains and mucus diarrhea. Early investigations show that there is a possibility of heterophyid eggs and adults reaching the heart via the circulation which may eventually result to cardiac failure.

Diagnosis of heterophyidiasis is done through stool examination and recovery of the characteristic eggs of the parasite.

A previous nationwide survey in 1967 revealed a 1% prevalence for heterophyidiasis but a recently concluded survey (2000) in Compostela Valley, a province in Mindanao, obtained a prevalence of more than 30% in the general population. Occurrence of heterophyidiasis is related to the eating habits and the level of environmental sanitation facilities in the community.

Drugs effective against the other trematodes are also effective against the heterophyids. There must be a strong advocacy through health education on eating only thoroughly cooked fish. Provision of sanitary toilets will definitely be useful but it should not be forgotten that there are reservoir animals that can continuously seed the environment with heterophyid eggs.

WATER-BORNE PROTOZOA

Water is a very essential compound for the survival of living things. It is also related to proper sanitation be it for personal hygiene or environmental sanitation. Water however, when unsafe and inadequate, may be associated with an enormous number of disease agents. Parasites related to unsafe water are mostly protozoan. For the parasitic infections included here, drinking water serves as a passive vehicle for transmission.

Entamoeba histolytica

This is the only pathogenic species of amoeba that can produce lytic substances that allows the parasite to invade tissues. The infective stage of this parasite is called cyst, which can be ingested from contaminated water and to some extent from contaminated food. Upon ingestion, the cysts go down into the digestive tract and in the lower part of the small intestines where the pH is slightly alkaline. Four new parasites called the metacysts will emerge. These metacysts will then move to the colon where they will develop into the trophozoite stage (See Illus. 15.10).

The trophozoites may develop back into the cystic stage when there is proper reabsorption at the descending colon or may remain as trophozoites if there is no proper water reabsorption. As trophozoites, they become capable of intestinal colonization resulting either in mucoidal stools with or without blood streaks. Sometimes, tissue invasion may be extended to the deeper layers of the intestines giving rise to ulceration of the mucosa, submucosa, muscle layer and even the serosa. The trophozoites are able to reach extra-intestinal organs like the liver, lungs and brain, where the parasites can establish amoebic abscess formation. As a matter of fact, trophozoites have been found in other organs like spleen, skin, peri-cardium and even the genitals.

Infected individuals harboring cysts are asymptomatic. However, they are cyst passers and can, therefore, be the extra source of infection in the community. This is where the problems on food-handlers come in.

Diagnosis is confirmed through the recovery of cysts from formed stools and trophozoites from diarrheic or watery stools. The consistency of stools dictates how soon the stools are to be examined in the laboratory. If what we expect to recover from the stools are trophozoites, the stools must be examined immediately because trophozoites are fragile and they die within 30 to 60 minutes outside the host.

Cysts and trophozoites can be detected through the direct fecal smear preparation. Nuclei of the cysts are best stained with iodine solution while nuclei of the trophozoites with methylene blue solution. Concentration techniques like formalin ether concentration (FECT), merthiolate iodine formaldehyde concentration (MIFC) and ZnSO₄ are very useful in the recovery of the cysts.

Skill in the identification of pathogenic amebae from non pathogenic ones can be acquired through proper training. It will be worthwhile to realize that using microscopic examination the cysts of *Entameba histolytica* have morphological characteristics very similar to two other amebae namely: *Entameba dispar* and *Entameba hartmanni*, the latter however happened to be a lot smaller than *E. histolytica* and *E. dispar*.

Transmission of amoebiasis is related to contaminated water supply, use of night soil as fertilizer and infected food handlers. Moreover, studies have shown that flies and cockroaches carry amoebic cysts as well. Boiling of drinking water from questionable source is a very good practice to avoid infection.

Specific drugs must be given to the patients. Health education emphasizing environmental sanitation must be done. Drinking water and food must be safe for human consumption. There must be regular examination of food handlers, which is now mandated by the provisions in the new Code of Sanitation approved by the Department of Health.

Identification of cyst passers will reduce transmission. In a recent study among food handlers in school canteens in the City of Manila, a high percentage was found to be positive to non-pathogenic amobae by stool examination. Even if the identified cysts were non-pathogenic, their presence indicates a possible danger of transmission to the food consumers once personal hygiene is not strictly practiced. Another indication is that, drinking water has been contaminated with human excreta.

Giardia lamblia

This is a flagellated protozoan which lives in the duodenum, jejunum and upper ileum of humans. It is also known as *Giardia duodenalis*, *G. duoduenalis*, *Lambliia duodenalis* or *L. intestinalis*. The disease caused by this protozoan is called giardiasis or lambliasis which has an incubation period of one to four weeks, averaging nine days. While it is asymptomatic in approximately 50% of infected individuals, it is manifested in mild cases as moderate and protracted diarrihea followed by spontaneous recovery in six weeks. In acute cases symptoms usually include cramping, abdominal bloating, nausea, anorexia, diarrheal stools, often with excessive flatus with an odor similar to that of rotten eggs. Chronic infection is characterized by passage of greasy, frothy stools.

Transmission of the *Giardia liamblia* parasite results from ingestion of mature cysts (infective stage) from feces of humans or animals (e.g. dogs, rats, horses) via contaminated hands, food or water. Ingested cysts pass through the stomach and excyst in the duodenum in about thirty minutes, developing into trophozoites which rapidly multiply and attach to the intestinal villi (Illustration 15.11). They cause pathological

changes like flattened villi tips, shallow crypts, inflammation of mucosa and hyperplasia of lymphoid follicles. The trophozoites may then be found in the jejunum. As the feces enters the colon and dehydrates, the parasite then encysts. Newly formed cysts have two nuclei while mature ones have four. After encystation, mature cysts are passed out in the feces and are then infective (Belizario and Solon 1998, pp. 38-41).

Laboratory diagnosis is made by demonstration of trophozoites and/or cysts in stool specimen or duodenal aspiration or biopsy. Duodenal aspirates can be collected through the so-called Entero-test or the String Test method. Prompt intervention reduces cyst passage and possible transmission particularly when food handlers, children in day-care centers, institutionalized patients and homosexuals are involved.

The prevalence of giardiasis is associated with poor environmental sanitation. Poor hygiene, overcrowding, immunodeficiency, bacterial and fungal overgrowth in the small intestines are important risk factors. Sanitary disposal of human excreta, proper management of reservoir animals, regular examination of food handlers and sanitary practices on food preparation and storage are crucial in the prevention and control of disease transmission. Boiling of drinking water may be required when potability is questionable.

Cryptosporidium hominis

This is an intestinal protozoan falling under Class Coccidia. There are about eight recognized species, of which only *C. hominis* is the only one known to cause infection in humans. A wide range of animals have been found to harbor the parasite as well.

It has been commonly isolated from both the small and large intestines. However, it has also been identified from other organs like the esophagus, stomach and appendix. Among the immuno-compromised and immuno-deficient patients, like AIDS victims, infection of the bile duct, gallbladder, liver, pancreas, and lungs have been reported.

This was initially thought to be an opportunistic parasite among AIDS patients but eventually it was found even among immuno-competent individuals. Among the immuno-competent individuals, diarrheal episodes are self limiting but among the immuno-compromised and immuno-suppressed individuals, diarrhea can be prolonged and may therefore result in more serious conditions.

Like any of the coccidian, the parasite undergoes the process of schizogony that results in the production of merozoites and sporogony which in turn develops oocysts. Both processes of multiplication occur in the extra-cytoplasm of the intestinal cells. When oocysts are passed out with the feces, they are already sporulated and are therefore readily infective.

Data show that ingestion of even a few oocysts can already establish infection in man. Patients with cryptosporidiosis often develop acute gastroenteritis possibly due to the ability of the organism as an enterotoxin. With prolonged symptoms, patients may eventually suffer from malabsorption resulting from villous atrophy and cellular infiltration of the lamina propria.

From the intestines, the infection may go up to the bile duct and the pancreatic duct, which would lead to cholangitis and pancreatitis. In some occasions, lung infections may be involved, causing the patients to suffer from respiratory symptoms like cough and shortness of breath.

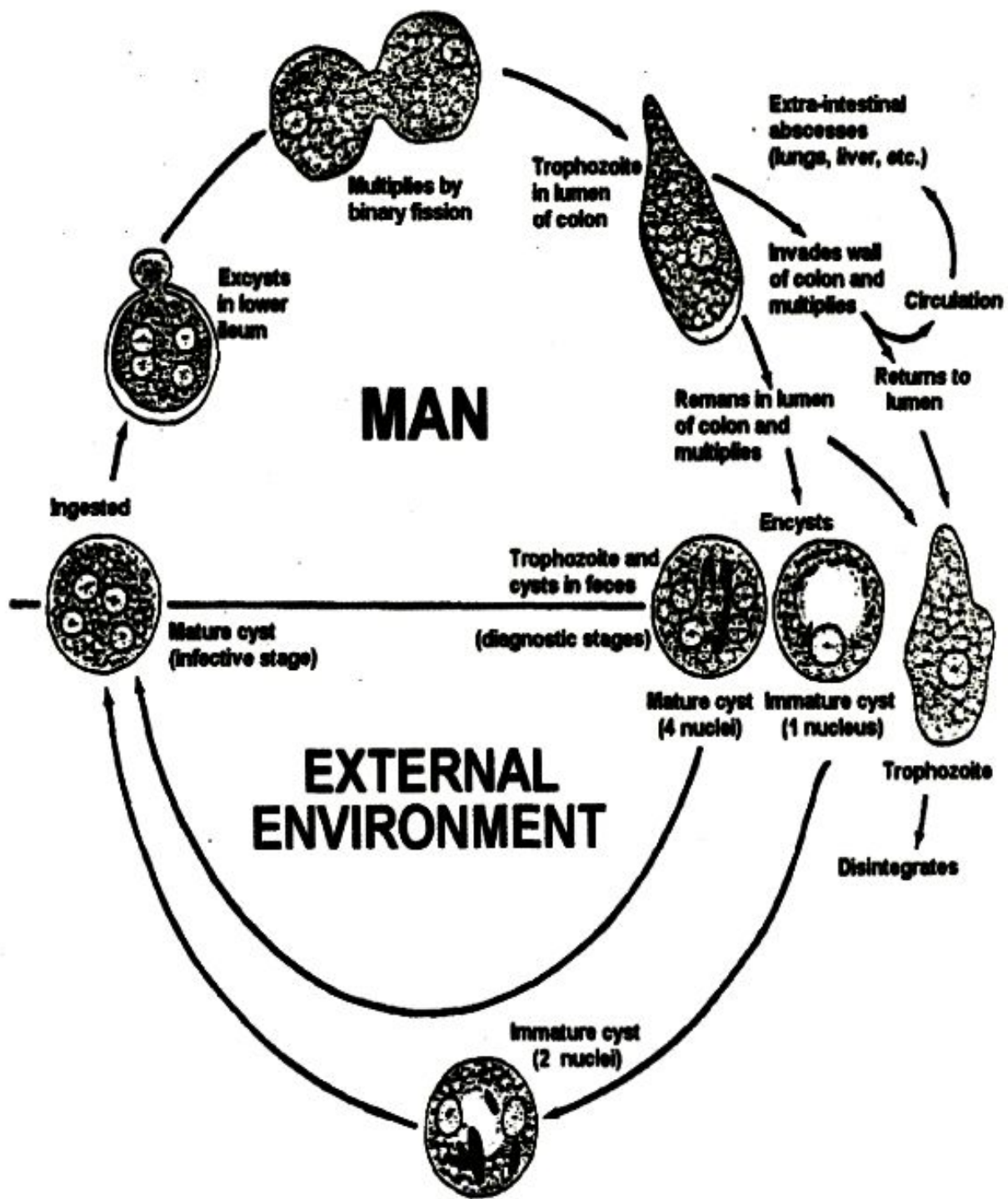


Illustration 15.10 Life Cycle of *Entamoeba histolytica*

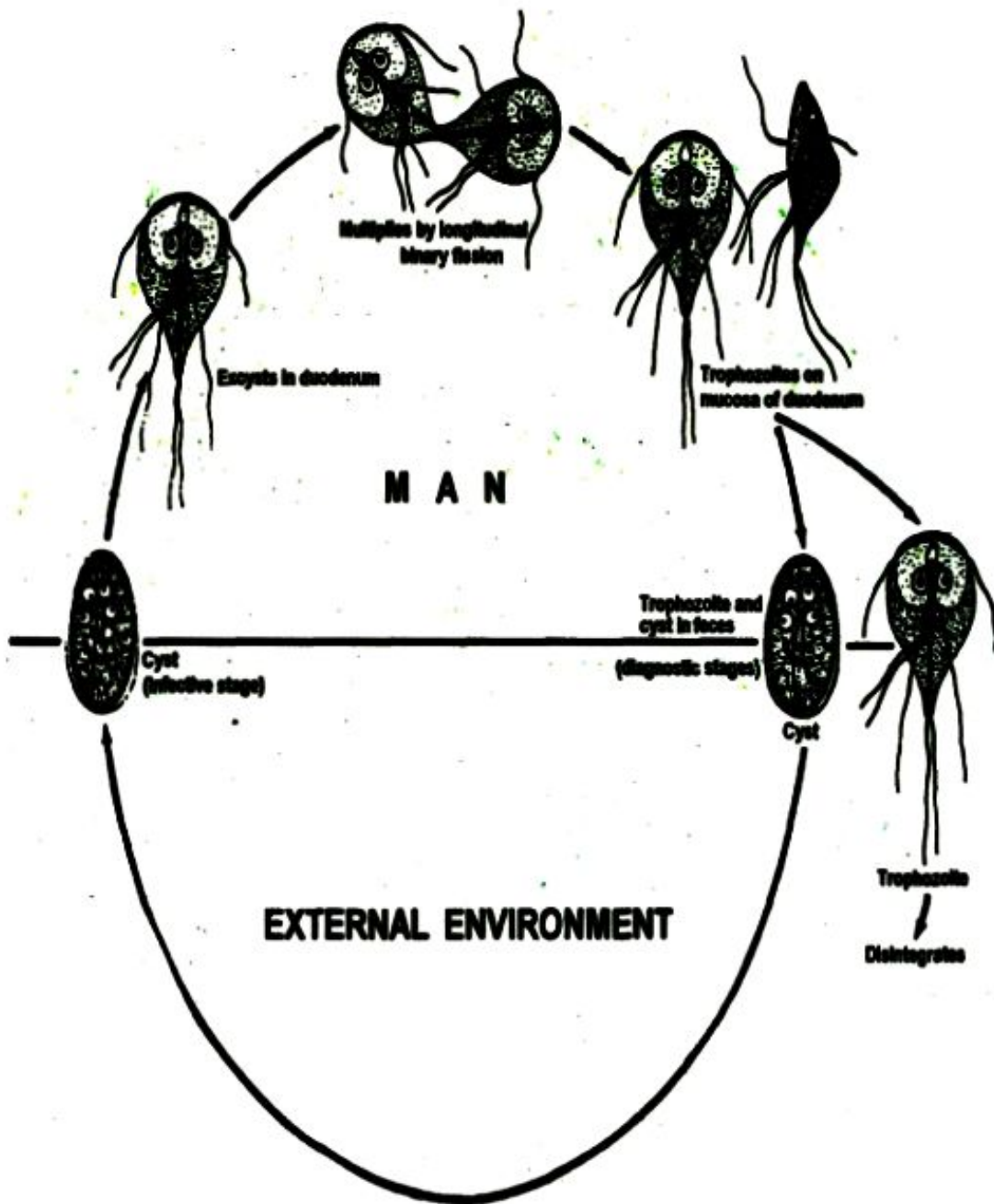


Illustration 15.11 Life Cycle of Giardia lamblia

Sources of the oocysts of *C. hominis* are variable, although the most common source is believed to be fecally contaminated drinking water. It is noteworthy to remember that oocysts in ice remain viable once it thaws. Accidental ingestion of pool or lake water contaminated with oocysts can also lead to infection.

High-risk exposure has also been associated to direct contact with feces positive for cryptosporidium hominis while caring for infected patients. This includes bathing, changing of diapers, changing of soiled bed linens or simple emptying of bedpans in caregiving institutions.

Infected food handlers with poor personal hygiene can accidentally transfer the oocysts to food and beverages. Raw fruits and vegetables may, likewise, be contaminated. Contact with infected calves in veterinary hospitals, in dairy farms or zoos have also been implicated as sources of human infection.

Diagnosis is established with the recovery of the oocysts from the stools. Oocysts are acid-fast and are identified best from stained stool samples with the modified acid-fast stain known as the Kinyoun's technique. Before staining, stools may be concentrated using Formalin Ether Concentration Technique (FECT) or with Sheather's flotation.

Since no chemotherapeutic agent has been found to be safe and highly effective for this parasite, the objective of treatment is to reduce the frequency of diarrhea. Rehydration is highly recommended.

To control and prevent infection, people must be strongly advised on personal hygiene and environmental sanitation. Sources of drinking water must be properly protected. Contact with infected individuals and animals must be avoided. Fruits and vegetables that are eaten raw must be properly and thoroughly washed.

Cyclospora cayatensis

This is another coccidian that has been isolated from patients with chronic and intermittent watery diarrhea. The diarrhea together with lack of appetite, loss of weight and bloating may last for weeks. However, the disease is generally self-limiting among patients who are immuno-competent. Like in cryptosporidiosis, prolonged diarrhea has been observed if the patients are immuno-compromised like the very young and the very old. Infection has been associated with consumption of contaminated food and water.

Like the Cryptosporidium, Cyclospora oocysts are also acid fast in nature and therefore can be stained with Kinyoun's technique. When viewed under an UV microscope, the oocysts emit a bluish fluorescence.

Blastocysts hominis

This is another protozoan parasite whose taxonomic classification is uncertain. It is usually mistaken for an amoeba and was formerly classified with the fungi. Association of this parasite with gastrointestinal pathology is still controversial, however, if this parasite is present in large numbers, a variety of intestinal disorders was observed, especially among children and the immuno-compromised. These include abdominal cramps, mild to moderate diarrhea, flatulence, nausea, and vomiting.

The life cycle and the modes of transmission are still unknown, although it is believed that transmission occurs through the fecal-oral route. Occurrence of blastocystosis

was associated with history of drinking untreated water and exposure to crowded, unsanitary conditions.

Diagnosis is based on the detection of the organism from the stools. It has been observed from direct fecal smear but sensitivity of the laboratory procedure is improved through the Formalin Ether Concentration Technique (FECT). The blastocysts vary in size with a diameter ranging from about 6 to 40 μm . They are generally spherical provided with a central body that occupies about 90% of the cell. Because of the large central body, nuclei of the parasite are almost always pushed to the periphery cell.

From a study of foodhandlers in a tertiary hospital located in Metro Manila and canteens operating in the University belt of the City of Manila, 40% and 24% of the students examined were found positive for *Blastocystis* cysts respectively.

VECTOR-BORNE PARASITES

There are certain groups of living things that carry and transmit infective agents to man. Some mechanically transmit the pathogens like the flies and cockroaches, while in some vectors, like mosquitoes, these infective agents undergo development and multiplication. This section covers parasites that are transmitted through these vectors.

Plasmodia

There are four species of *Plasmodia* causing malaria in man, namely: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae* and *Plasmodium ovale*. All of these species are transmitted through the bite of the infected female mosquitoes belonging to the Genus *Anopheles*. In the Philippines, the major mosquito vector is the female *Anopheles minimus flavirostris*.

The most common cause of malaria in the Philippines is *Plasmodium falciparum*. About 70% of all malaria cases are due to *P. falciparum*, 30% are due to *P. vivax* and less than 1% is due to *P. malariae*. *Plasmodium ovale*, however, is believed to be absent in the Philippines. On the other hand, a monkey malarial parasite called *Plasmodium knowlesi* was identified from indigenous people in Mindanao by the Research Institute for Tropic Medicine.

Among the *Plasmodia* species, *P. falciparum* is considered to be the most dangerous because it causes severe complications such as cerebral involvement. Among children in endemic areas, chronic infection with malaria can lead to childhood anemia. Pregnant women when infected with malaria may suffer from stillbirths and abortion.

Plasmodia undergo an asexual method of multiplication in man called schizogony and gametogony. This makes man as the intermediate host. The asexual multiplication is periodic and the length of schizogony differs from one species to another. The sexual method of multiplication called sporogony occurs in the mosquito, the definitive host.

In man the malarial parasites undergo schizogony in the red blood cells and for this reason, these parasites may be transmitted through indiscrete blood transfusion. Stages that develop during schizogony are trophozoites which will then become schizonts, inside of which are merozoites. Schizogony was shortest in *P. falciparum* but longest in *P. malariae*. The highest number of merozoites are produced by *P. falciparum*, while the fewest are produced by *P. malariae*. When the schizonts are mature, the host red cells rupture and the merozoites are released into the circulation. It is at this point when

man usually suffers from the malarial paroxysm accompanied by chills, fever, profuse sweating headache and prostration. The merozoites will enter new red blood cells to repeat the schizogonic cycle. Some merozoites will, however, develop into gametocytes that are taken up by the female *Anopheles* during feeding time.

In the mosquito gut, the gametocytes become sexually mature gametes. The male gamete fertilizes the female gamete to produce a fertilized cell called a zygote. The zygote develops into an ookinete then into an oocyst. Inside the oocysts are sporozoites which are released into the salivary glands of the mosquito and are eventually introduced to a new host when the mosquito vector takes another blood meal (See Illus. 15.12). Sporozoites introduced by the mosquito bite undergo exo-erythrocytic schizogony in the liver cells. The merozoites released from the liver cells will eventually invade the red blood cells.

The interval between malarial attacks is determined by the length of asexual phase: 36-40 hours for *Plasmodium falciparum*, 48 hours for *Plasmodium vivax* and *Plasmodium ovale*, 72 hours for *Plasmodium malariae*.

Thick and thin blood films are prepared from a finger prick on the patient. The blood films are stained with Giemsa and are read under the oil immersion lens. The thick blood smear is useful for rapid diagnosis while the thin blood film is used for species identification. In *Plasmodium falciparum* infection, what can be seen from the blood films are mainly rings and gametocytes because the late trophozoites and schizonts are sequestered in the deep vasculature of some internal organs. While for the other three species, all asexual stages can be recovered from the peripheral blood.

If the blood films are negative, serological tests like IFA (Indirect fluorescent antibody) and ELISA (Enzyme linked immuno sorbent assay) are available to detect antibodies. Recent advances in the diagnosis of malaria include antigen detection from the blood using monoclonal antibodies against enzymes produced by the parasites like histidine-rich protein (HRP) and lactic dehydrogenase (LDH).

Treatment is available for both uncomplicated and complicated forms of malaria. Chemoprophylaxis is also suggested to protect man from malaria infection. For the control of the mosquito vectors, experts recommend the integrated vector control strategies which include stream modification and/or other environmental manipulation, biological control, and chemical control. To prevent man-vector contact, use of chemically treated bednets and proper screening of houses are advocated. Long lasting insecticide treatment nets (LLITN) are now available. Families are advised to use adequate protective clothing during outdoor activities at night when the biting period of the mosquito vector is expected until early morning (de las Llagas, 1999: 23)

Community-based family empowerment interventions for malaria prevention and control have been documented in 1999 by Maglaya, de las Llagas, Ancheta and Belizario (See Chapter 18).

***Babesia* spp**

This parasite belongs to a group of protozoans called piroplasms. Human infection with *Babesia microti* has been identified mainly in the United States and to a lesser extent in Europe. In the United States problem on *Babesia* is compound by the fact that the spirochaete called *Borrelia burgdorferi* causing Lyme diseases is transmitted by the same tick *Ixodes* spp which transmits *Babesia*. Just like the *Plasmodia* spp, this parasite is intra-erythrocytic in habitat. It is, therefore, transmissible through blood

transfusion. In babesiosis, however, the invasion of the red blood cells will eventually lead to hemolytic anemia.

Babesia microti is biologically transmitted through the bite of hard-bodied ticks called *Ixodes scapularis*, which usually feed on white-tailed deer. The tick also feeds on smaller mammals like the white-footed mouse which is the major reservoir host of *Babesia* spp. Incidentally the tick is also the vector of Lyme disease caused by a spirochaete named *Borrelia burgdorferi*. In endemic places, it is common that an individual is simultaneously infected with both Lyme disease and babesiosis.

Diagnosis of babesiosis is established when Giemsa-stained blood films reveal the presence of the parasites. The ring forms of *Babesia* spp are very difficult to differentiate from the ring forms of *Plasmodium falciparum*. The tetrads called the Maltese cross are however diagnostic, while Polymerase Chain Reaction (PCR) is very useful in low parasitemia. Detection of antibodies by serology is also useful.

Clindamycin is an effective antibiotic against babesiosis. Use of protective clothing like the wearing of long pants and sleeves are also recommended. Clothing can even be impregnated with insecticide.

Wuchereria bancrofti* and *Brugia malayi

These parasites cause lymphatic filariasis and are transmitted by female mosquitoes. *Wuchereria bancrofti* is transmitted by mosquitoes falling under genera *Aedes*, *Anopheles* and *Culex*. In the Philippines, however, the parasite is transmitted by *Aedes poecilus* which breeds pretty well in the axils of the abaca and banana plants. In some areas, *Anopheles minimus* is the mosquito vector identified in the Mountain province. *Culex* mosquitoes have been incriminated but they are more important vectors in other countries. On the other hand, *Mansonia* mosquitoes are responsible for the transmission of *Brugia malayi*.

Adults of the above parasites habitate the lymph vessels and/ or lymph nodes. The progeny called microfilariae are found in the peripheral circulation. The presence of the microfilariae in the circulation exhibits a rhythmical pattern called periodicity. When the mosquitoes take a blood meal and they pick up the microfilariae, the microfilariae will develop into first (L1), second (L2) and third (L3) stage larvae in the muscles of the mosquitoes. When the mosquitoes bite a susceptible host, the 3rd stage larvae are deposited on the skin and the larvae actively enter the skin through the site of the bite. They will eventually reach the lymphatic system and the worms will develop into the adult filarial worms (See Illus. 15.13 and Illus. 15. 14).

In the early stage of lymphatic filariasis, the infected individual suffers from fever with inflammation of the lymph glands. There is recurrent retrograde lymphangitis with localized swelling and redness of the arms and legs. This is believed to coincide with the release of microfilariae by the female worms. When the adult worms die, there will be an immunological reaction resulting in lymphatic obstruction which in turn can lead to elephantiasis or hydrocoele.

It is worth mentioning that there are microfilariae positive individuals who are asymptomatic. A few, however, manifests the characteristic tropical pulmonary eosinophilia where patients do not manifest microfilaremia because the microfilariae are in the tissues. They have hypereosinophilia and usually suffer from pulmonary symptoms like paroxysmal coughing.

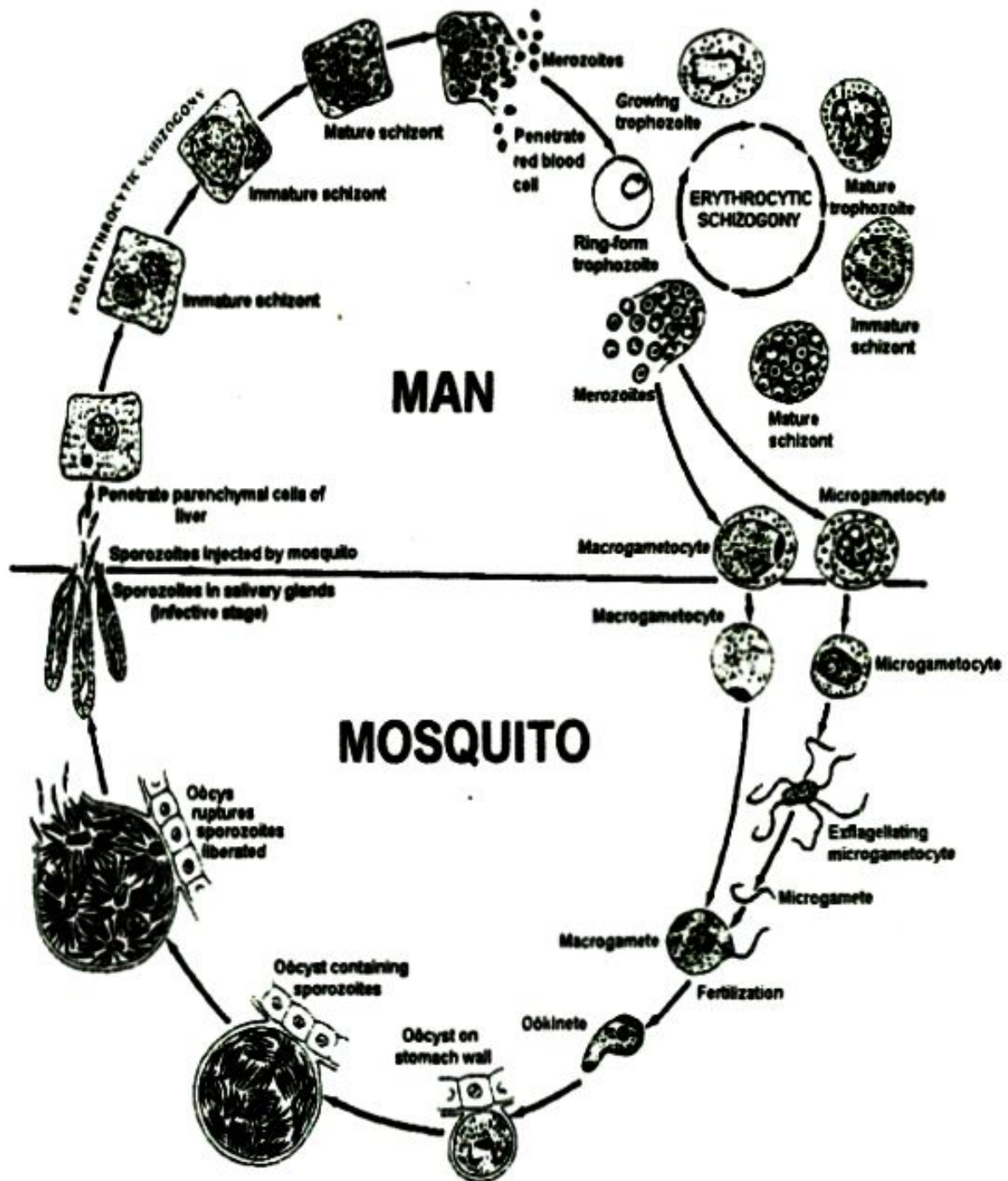


Fig 15.12 Life Cycle of *Plasmodium vivax* causing Malaria

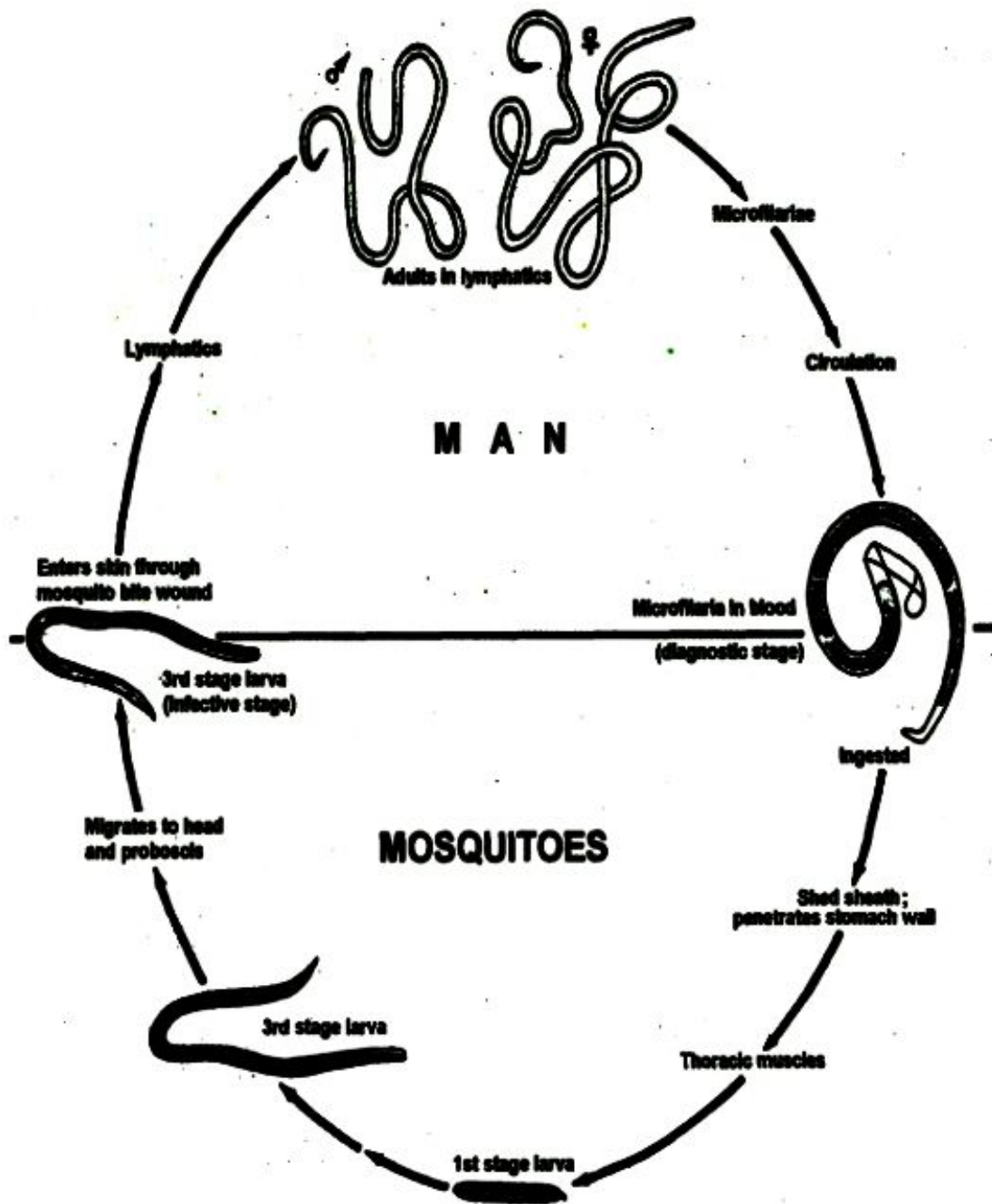


Illustration 15.13 Life Cycle of *Wuchereria bancrofti*

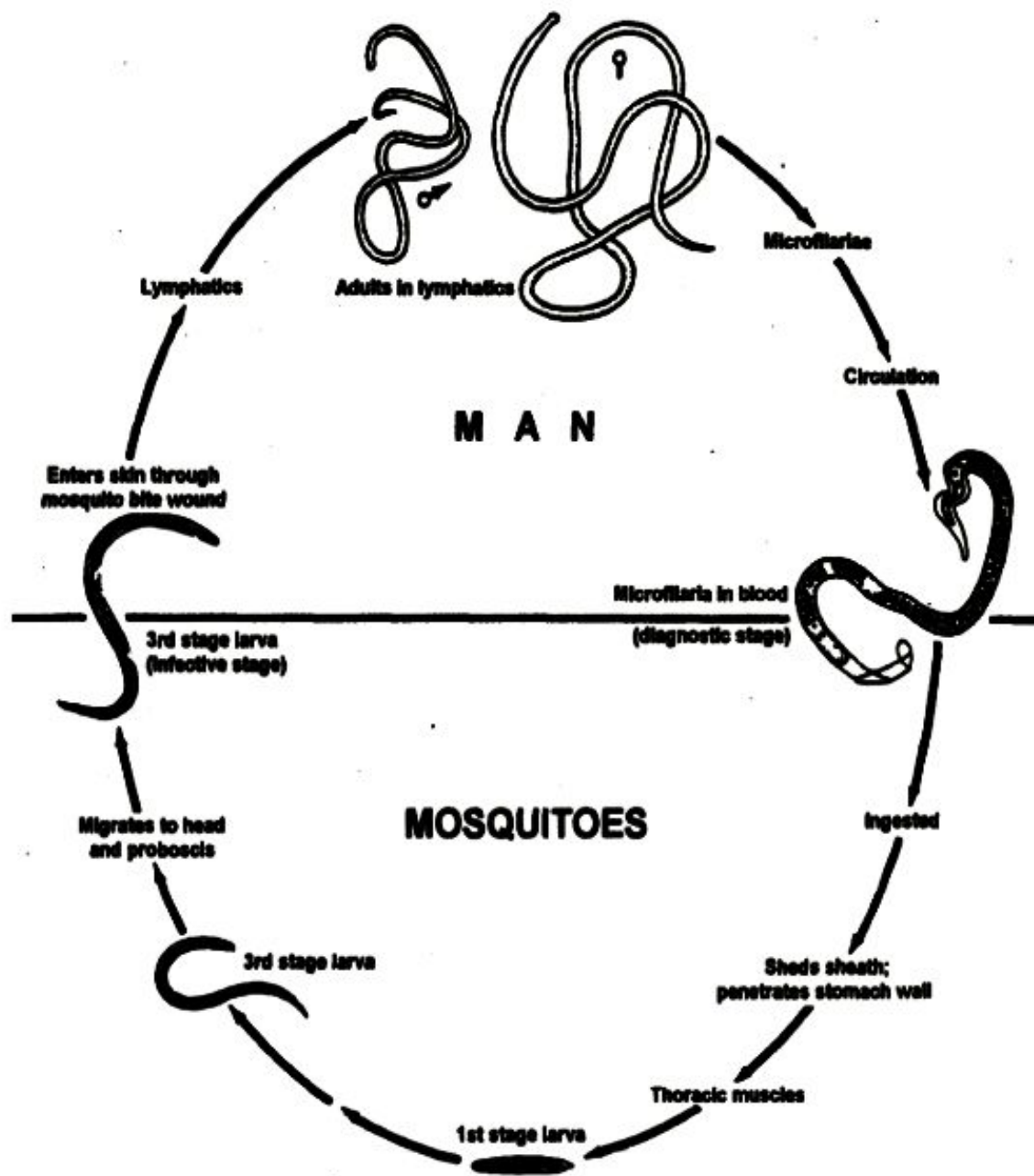


Illustration 15.14 Life Cycle of *Brugia malayi*

Diagnosis of filariasis is established with the recovery of microfilariae from stained thick blood films. *Wuchereria bancrofti* microfilariae exhibit nocturnal periodicity while *Brugia malayi* microfilariae exhibit nocturnal but subperiodic periodicity. Because of these characteristic periodicity, blood samples must be collected from 8:00 pm to 4:00 am. To increase the chance of finding microfilariae, concentration techniques called Knott's technique and nucleopore filtration are recommended.

Filarial antigens can also be detected from the blood using a monoclonal based card test, called the ICT card test.

In the Philippines, *Wuchereria bancrofti* has a wider geographic distribution compared to *Brugia malayi*. Bancroftian filariasis has been reported in Camarines Norte, Camarines Sur, Albay, Sorsogon, Mindoro, Marinduque, Masbate, Palawan, Samar, Leyte, Bohol, Mountain Province, all of Mindanao especially Sulu, Tawi tawi, Basilan and Zamboanga. On the other hand, Malayan filariasis is present in Palawan, Eastern Samar, Agusan and Sulu.

Effective drugs are available for the treatment of filariasis. A combination of diethyl carbamazine and albendazole is being utilized for the so called mass drug administration (MDA) to eliminate lymphatic filariasis. Health education should focus on the prevention of man-mosquito contact like the use of bed nets, repellants and chemical spraying. The use of *Bacillus thuringiensis* as biological control has also been tried.

Schistosoma japonicum

This is a fluke. Among the flukes, this is the only species provided with separate sexes. Adult worms live in the portal and mesenteric veins of man and a wide range of reservoir animals like rats, monkeys, pigs, dogs, carabaos and cows.

Schistosoma eggs are deposited in the mucosal capillaries where they undergo maturation and are eventually able to enter the intestinal lumen via ulcerations. Upon reaching a body of water, the embryo called miracidium is released. The miracidium then enters the snail intermediate host which is scientifically called *Oncomelania hupensis quadrasi*. Within the snail host, the miracidium develops into two generations of sporocysts then into cercariae. The cercaria is the infective stage and it can actively penetrate the human skin. After skin penetration, the cercaria develops into juvenile adult called schistosomula. It will enter the circulation, undergo tissue migration until it reaches the portal veins where it will develop into adult schistosome (See Illus. 15.15).

Entry of the cercariae into the skin may or may not result in dermatitis. At the time of egg deposition in the intestines, patient starts to manifest diarrhea with blood. The deposition of eggs in the tissues, mainly the liver, results in granuloma formation. This usually leads to portal hypertension with hepato-splenomegaly, ascites and emaciation. Many reported cases of death due to schistosomiasis were caused by rupture of esophageal varices.

Diagnosis of schistosomiasis is confirmed with the recovery of the eggs from the stool through Acid-Ether Concentration (AECT) or Kato-Katz technique. Eggs embedded in tissues can be seen from rectal biopsy material. A serological test to detect antibodies called Circumoval Precipitin Test (COPT) is usually requested together with stool examination.

Schistosomiasis is found in the Luzon provinces of Mindoro Oriental, Sorsogon, Visayas provinces of Samar, Leyte, Bohol and in all provinces of Mindanao, except Misamis

Oriental. New foci of infection have been found in Gonzaga, Cagayan Valley in Luzon and Calatrava, Negros Occidental in the Visayas.

Drug for treatment is available. Advocacy for the proper disposal of human feces, control of reservoir animals and snail control help in the control and prevention of the infection.

CONCLUSION

Knowledge of the life cycle of each parasite helps determine appropriate nursing interventions to prevent or control its transmission. Most of the parasites described in this chapter are excreta-related and are mainly able to leave the host via the feces. Therefore, unsanitary waste disposal is a very important factor that contributes to the continuous transmission of these parasites. Some have animal reservoir hosts or intermediate hosts which complicate prevention and control strategies. Unsanitary garbage/refuse and waste disposal can also encourage mechanical transmission of these pathogens through arthropods like flies and cockroaches.

Community health nurses are challenged to be creative and innovative in designing and implementing prevention and control interventions which require partnership and empowerment processes (Maglaya 1999). Examples of these strategies to prevent or control parasitic infections include:

1. Client-centered nursing interventions to facilitate development of healthy lifestyle, motivating clients and supporting their learning through each stage of the behavioral change process (Refer to Appendix E); Emphasis on personal hygiene, sanitary food preparation, safe eating and drinking habits/practices, use of sanitary toilet facility and use of self-protection measures such as wearing of appropriate footwear or sleeping under insecticide treated bed nets especially in endemic areas.
2. Advocacy, partnership and collaboration with the community, the local government unit and the partner agencies to ensure the provision of safe water supply (specially from public sources) and appropriate facilities for garbage/refuse and waste disposal. Refer to Chapters 5, 6 and 9 for strategies and interventions.
3. Community-based and family-centered empowerment strategies (see Chapter 18) to eliminate breeding and resting sites of mosquitoes (de las Llagas, 1999), snails, other vectors, intermediate hosts and mechanical carriers (e.g., flies, cockroaches, rats) of parasites.